THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THE FUTURE OF ELECTRO-METALLURGY.

PERHAPS no branch of electrical science has a greater future before it than Electro-metallurgy. Practical applications of the discoveries with which the general subject is inseparably connected were made at a very early date. In 1805 Brugnatelli gilded two silver medals by making them the negative pole in a solution of ammoniuret of gold. In 1839 Jacobi published a description of his famous galvano-plastic process, by which *facsimiles* of objects could be produced in copper. Since that date the progress of the art was rapid. Jordan, Spencer, and, notably, Messrs. Elkington, advanced the utility of the processes, and the latter gentlemen, whose names are widely known in connection with electro-plating, established the latter art as a profitable commercial speculation on a firm and lasting basis. Many other workers whose names are but little known, except in a small circle, have assisted in extending and refining the processes in connection with the art, and it is a matter for some surprise that a trade, which is at present of very large dimensions has attracted but little public attention. The recent issue of a monthly publication, whose object is to give to electro-metallurgy the same amount of public notice which other branches of electrical science are receiving, may, perhaps, excite more interest in the subject, which is likely to prove of the very highest commercial importance. The question of the conversion of power, by means of dynamo-electric machines, into light, heat, and motion, which has been so satisfactorily, and more or less completely, solved, has an important bearing upon the question. At a recent lecture Dr. Siemens showed the value of the electric arc for the fusion of metals, the principle involved being that of concentrating an enormous heat in and around a small space. In this particular case an instance is given of an indirect method of concentrating heat, viz., the coal is consumed in a steam-engine, and the heat generated re-appears in the form of the electric arc. If the dynamo machine were turned by water-power the same heat could, of course, be produced. Thus we should have materials melted without what is commonly understood by fuel.

Now, it is well known that in many countries the working of metalliferous mines has ceased to be attended with the profits which were formerly obtained from them, chiefly on account of foreign competition; but if it were possible to effect the reduction of the ore raised by a cheap fuel on the spot a great revival of the mining industry would ensue At the present time mining in Cornwall and Devon would be considerably advanced were fuel for smelting purposes available in the locality at a cheap rate; at present the coal for the purpose has to be conveyed at a considerable expense from a distance, or, on the other hand, the mining products have to be conveyed to the neighbourhood of the coal-pits, the expense of carriage in either case being heavy. Now, in both Devon and Cornwall the fuel exists, not in the form by which it is commonly known, but it exists in the numerous streams and waterfalls, and in the tide which surrounds their iron-bound coasts. The conversion of motive power into electricity and heat has been proved to be possible. Will some scientific and commercial genius practically apply the knowledge which has been obtained? The theoretical possibility of the idea we have suggested is, we imagine, unquestionable; its practical possibility, we think, is as certain.

Whilst advocating the application of electricity to the smelting of metalliferous ores by means of power converted into heat by electricity, we would by no means insinuate that the reduction of the ores must necessarily be effected in this way. The science of electro-metallurgy daily shows that metals may be reduced from their salts by the electric current; cannot it effect the reduction of metals from their natural earthy condition by a process equally simple with that of electro-plating, and do it in an economical manner? The motive power necessary to effect the results exists in inexhaustible quantities; it only wants to be applied. Let electro-metallurgists and electricians puzzle the question out, as we feel certain they will do in time, and another triumph will be won by means of electricity.

CROMPTON'S ELECTRIC LAMP.

IN general principle this lamp possesses but little novelty; it is rather a refined and well designed arrangement adapted from old patterns, but the improvement effected by the intelligent carrying out of first principles renders the lamp one of the best yet designed.

There are two distinct movements in the lamp, by one the carbons are separated to a definite distance, and by the second they are allowed to approach together until checked by a slight increase in the current, consequent thereon.

In effecting the latter object the mechanism is made very sensitive in its action, but this sensitiveness is not obtained at the cost of simplicity and solidity of mechanism.

A general view of the mechanism will be seen from figs. 1 and 2. The starting and stopping action which allows the carbons to approach one another or to lock them, and the separation of the carbons to a definite distance in the first instance, is effected by one electro-magnet; this magnet has an armature

Fig. 1.

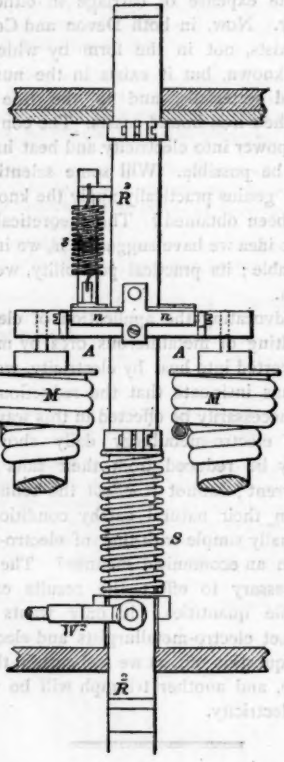
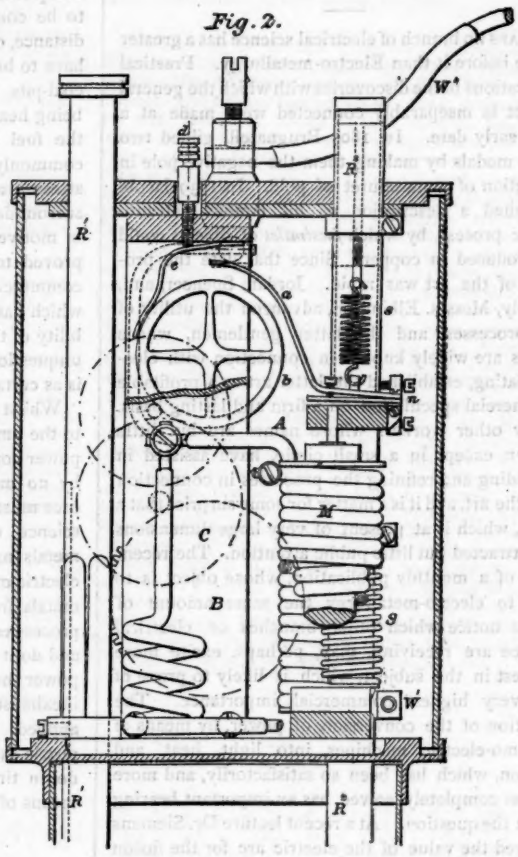


Fig. 2.



divided into two parts—the lower and larger part, A, is attached to the rod, R_2, which forms the lower carbon holder, and has to do the rough work of separating the lower carbon from the upper one, and thus making the arc in the first instance, or of re-making it, if by any accident, such as a violent gust of wind, or breakage of carbon, it should be extinguished when the lamp is not working.

This armature and lower carbon holder is held up by a large spiral spring, s. When the current is switched on, and passes round the electro-magnet, the latter overcomes this spring, pulls down the armature and forms the arc, thus maintaining the lower carbon in a fixed position so long as there is a current passing.

The smaller variations of current, which are caused to actuate the feed of the upper carbon, are responded to by a very light plate, or secondary armature, *n*; this is hinged on to the large armature, A, and is suspended above it by a very light hair-spring, *s*, the tension of which can be varied by the regulating screw of the lamp. This secondary armature, which is formed of soft iron, carries a curved arm, *a*, which acts as a brake on the last wheel, *b*, of a clock-work train: the latter is set in motion by the weight of the positive carbon rod, R_1, which has a rack cut in it gearing into the wheel, B.

The parts actuated by the varying magnetic force induced in the armature, *n*, only weigh a few grains, and consequently are very sensitive, and it is quite usual for the armature to rise and fall six or eight times for each revolution of the brake-wheel, *b*, which represents a feed of from one to

two hundredths of a millimetre; the feed, therefore, is practically continuous and causes the light to be proportionally steady.

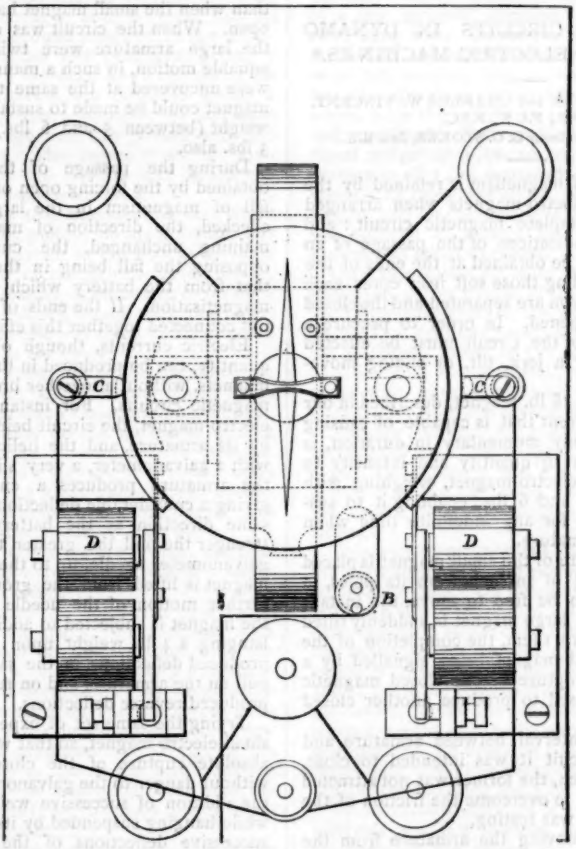
The pinion into which the wheel, B, gears is not fixed to the wheel, C, but is connected to the latter by a ratchet wheel, so that the rod, R_1, can be drawn up when it is required to insert a new carbon, without turning all the wheels in the train.

The course of the current through the electro-magnet and carbons is quite simple; thus, the current entering at W_1, passes through the electro-magnet, M, direct, thence to the frame of the apparatus and the upper carbon, and from there to the lower carbon and back to the dynamo machine.

The screw, *d*, when screwed down presses the strap, *e*, against the brake-wheel, *b*, and prevents it from turning; this is only required for security during transport.

ROGERS' PATENT NEEDLE SOUNDER.

THIS invention is intended to afford a ready means of converting the ordinary single-needle instrument into a sound-reader at will. A reference to the accompanying illustration will explain the simple and inexpensive way in which this is effected. The local battery terminal is in metallic connection with the pillar, B, which makes a rubbing contact with the dial plate. The ivory pins controlling the play of the needle are removed and replaced by platinum or silver pins soldered to brass strips at the back of the dial plate, but insulated from it by ebonite or waxed paper, and these strips are in



contact with two springs, C, leading to the sounder, S, D, the return wires from which are connected to the other local terminal. A switch is placed outside the case of the instrument in any convenient position to enable the sounder to be cut out when required. It will be seen that the needle is the current carrier, and when the sounders are switched in they reproduce its motions in sound. If desired, one sounder only can be used when the clerk can read or send the Morse Code, the spacing or time interval necessary for reading it being quite as easily produced by the tapper or drop handle as by the ordinary key. For noisy railway cabins the sounder can be replaced by a bell for calling the attention of the signalman. The sounder can be connected to the ordinary line battery in place of a separate local one if more convenient.

ON MAGNETIC CIRCUITS IN DYNAMO AND MAGNETO-ELECTRIC MACHINES.*

By LORD ELPHINSTONE and CHARLES W. VINCENT, F.R.S.E., F.C.S., F.I.C.
Communicated by Professor G. G. STOKES, Sec. R.S.

A LARGE amount of magnetism is retained by the soft iron cores of electro-magnets when arranged so as to form a complete magnetic circuit: and sparks and other indications of the passage of an electric current can be obtained at the ends of the helix wires surrounding those soft iron cores each time the masses of iron are separated and the closed magnetic circuit opened. In order to procure a spark the breaking of the circuit must be effected suddenly, either by a jerk, tilt, or sliding movement.

In the case of the 58 lb. magnet, described in our former note, the current that is capable of causing a spark, although only momentary in duration, is found to be sufficient in quantity and intensity to magnetise a small electro-magnet, weighing, with its coils, between 5 and 6 lbs., enabling it to sustain its own weight for any indefinite time when suspended by its armature.

When the armature of the small magnet is placed at the distance of $\frac{1}{8}$ of an inch from its poles, in such a manner as to be free to move, the instant the armature of the large magnet is suddenly tilted or slid off it darts to them, the completion of the circuit of the small magnet being signalled by a smart click. The rupture of one closed magnetic circuit is thus caused to produce another closed magnetic circuit.

But when the interval between armature and magnet, whose circuit it was intended to close, exceeded $\frac{1}{4}$ of an inch, the former was not attracted with sufficient force to overcome the friction of the table upon which it was resting.

The mode of removing the armature from the large magnet appeared to be of no moment, but the time occupied by the removal had much influence upon the amount of magnetic force manifested in the smaller circuit. This was particularly the case if there were an interval, no matter how small, between the armature and the poles of the magnet round which the electric current was sent.

For example, if with an interval of $\frac{1}{16}$ of an inch between the armature and the poles of the small magnet, the armature of the large magnet was slowly slid off, the magnetisation of the small magnet never rose to a sufficient intensity to draw its keeper to itself, whereas, when the sliding took place rapidly, the small armature was strongly attracted as above mentioned.

The largest amount of magnetisation was bestowed upon the small electro-magnet by the interaction, when it was held upright, its poles being completely covered by a closely fitting armature. And it was also found that when thus set up in preparation for the formation of a closed magnetic circuit, the magnetisation was produced by a much slower motion of the large armature than when the small magnet had its circuit partly open. When the circuit was completely closed, if the large armature were twisted off by a slow equable motion, in such a manner that both poles were uncovered at the same time, then the small magnet could be made to sustain not only its own weight (between 5 and 6 lbs.) but an additional 3 lbs. also.

During the passage of the electric current, obtained by the forcing open of the closed circuit, fall of magnetism in the large magnet itself is checked, the direction of magnetic polarity remaining unchanged, the current checking or opposing the fall being in the same direction as that from the battery which caused the primary magnetisation. If the ends of the helix wires are not connected together this effect is not obtained.

Electric currents, though of less intensity and quantity, can be produced in the helices of electro-magnets, without altogether breaking up the closed magnetic circuits. For instance, with the 58 lb. electro-magnet, the circuit being completely closed by its armature, and the helices being connected with a galvanometer, a very slight pull applied to the armature produces a current of electricity, giving a considerable deflection of the needle in the same direction as the battery current; and the stronger the pull the greater the deflection of the galvanometer needle, up to the point at which the magnet is lifted from the ground, after which no further motion of the needle is produced, unless the magnet is subjected to additional strain. Thus, hanging a 4 lb. weight upon the uplifted magnet produced deflections in the same direction as the pull on the armature, and on removal of the weight, produced reverse deflections.

Trying the same set of experiments with a very small electro-magnet, so that we might proceed to absolute rupture of the closed magnetic circuit without danger to the galvanometer, we found that the addition of successive weights to the magnet while hanging suspended by its armature produced successive deflections of the galvanometer, the needle coming to rest at zero after each addition, as in the case of the large magnet.

When the maximum weight which the magnet was capable of sustaining was reached, and a real movement of the armature commenced, the in-

* Read before the Royal Society.

duced current in the helix of the electro-magnet was very greatly increased by the addition of even the smallest weight.

From these experiments it may be inferred that in like manner as the passage of an electric current round a bar of iron produces elongation of the bar, so the elongation of the bar produces in its turn an electric current in the helix; and this current tends to strengthen the magnetisation, and also that a magnet is absolutely stronger under tension than when at rest.

On the other hand, pressure on the armature, either continuous or sudden and momentary (a blow for example), causes an electric current in the helices in the opposite direction to original magnetisation, or in other words, against magnetisation; tending thereby to weaken the power of the magnet.

The 58 lb. magnet in closed circuit was hung by its armature, and on afterwards connecting its helices with the galvanometer no current could be detected, but on lowering it until it rested with its whole weight on the ground a current in the direction of demagnetisation was produced, giving a deflection of 15°. In the same way a current in the direction of magnetisation was obtained, giving a deflection of 15°, by the application of sufficient strain to lift the magnet off the ground, and this result was invariable. The degree of swing, however, depended upon the rapidity with which the magnet was either raised or lowered.

It may be remarked that whereas any very slight application of force by pulling on the armature was sufficient to cause a current in the helices giving a deflection of 5° to 10° of the galvanometer needle, a great amount of pressure is necessary to produce a similar deflection. A slight pull with the finger and thumb in the one case was equal to the pressure of a hundredweight in the other.

By the momentary removal of the armature, the closed magnetic circuit is broken, and though by its immediate restoration a new closed circuit is formed, nevertheless the tension on the molecules of iron by the magnetic stress is very greatly reduced. Under these conditions a very slight pressure upon the armature produces a great swing of the needle, whilst a pull produces scarcely any effect at all until actual movement of the armature takes place.

If the pressure on the armature is great and continuous, a point is soon reached at which a slight pressure is no longer effective.

The effects produced are somewhat different if pressure is applied unequally. For instance:—A weight of 7 lbs. placed on the armature over the north pole of the 58 lb. magnet caused a current in the helices giving a deflection of 20° at the galvanometer. The same weight on the south pole gave the same deflection in the opposite direction. Pressure with the hand produced like swings of the needle proportionate to the force used, and the amount of swing can be easily controlled and the needle brought to rest by judicious pressure on either pole of the magnet.

If a lateral pressure be applied to one side of the armature between the poles, and the needle swings, say, 5° on removal of the pressure, a current is produced in the opposite direction, and the reverse swing in place of being 5° will be 8°, and so on in proportion to the amount of force made use of.

None of the above-mentioned effects could be shown with the small magnets under pressure; and it was not found possible to produce a recognisable current without actual movement of the armatures.

Under certain circumstances the attractive force of electro-magnets in closed magnetic circuit is found to increase with lapse of time. For example:—A small U-shaped electro magnet with limbs 6 inches long, having a core of ¾-inch iron, and helices consisting of four layers of No. 16 covered copper wire, when excited by four Bunsen cells, supported as an armature a similar U-shaped iron bar, but without a helix upon it; this latter remained firmly attached after the voltaic current had ceased, but the hanging on to it of an additional weight of 3 lb. 6 oz. instantly wrenched it away from the electro-magnet, and broke the closed magnetic circuit.

The magnet was then re-excited, the armature being fixed to the electro-magnet by being held in contact with the poles whilst an electric current, of a few seconds' duration, passed through the circulating wire. In place of immediately attempting to add any additional weight, the two iron U's were left hanging face to face, in the form of the link of a chain, for twenty-four hours, at the end of which time the weight of 3 lbs. 6 oz. was hung on and sustained. Forty-eight hours later, an additional weight of 3 lbs. 10 oz. was carefully added, making in all 7 lbs. sustained. Twelve hours afterwards 1 lb. more was added, bringing up the entire weight to 8 lbs. beyond that of the armature; this was suffered to remain for five days, when the system was taken to pieces.

On a subsequent occasion the same magnet sustained an entire weight of 10 lbs. beyond that of the U-shaped armature, the weight sustained being reached by beginning with an amount well within the sustaining power of the electro-magnet wire in closed circuit, and increasing it by small additions made with intervening intervals of time varying from twelve hours to several days.

Another and smaller U magnet was likewise experimented on; this weighed with its coils 3 lbs. 6 oz. Its armature was a strip of soft iron completely covering the poles, and having a hook in the centre, to which weights could be easily attached.

This electro-magnet was excited by the passage, for a few seconds, of the current from two one-pint bichromate cells. On breaking battery contact, the armature failed to sustain 4 lbs. The electric current was again sent round the electro-magnet, and the armature was pressed against the poles, being carefully adjusted so as to cover them completely, and at the same time to place the hook precisely in the centre, so that the pull should be fair and equal when a weight was hung upon it. By this careful manipulation, on breaking contact with the bichromate cells, the closed magnetic circuit was found capable of sustaining the 4 lb. weight.

By successive additions of 2 oz. weights, made at intervals of a few minutes, the weight hanging to the armature was raised to 5 lbs., after which the attempted addition of 2 oz. caused the disruption of the system.

The experiment was repeated under similar conditions, but with slightly extended intervals of time between the additions of the weights. The magnet

in closed circuit was made to hold 4 lbs. 2 oz., 4¼ lbs., 4½ lbs., 4 lbs. 14 oz., 5 lbs. 2 oz., the time taken in all, for the successive additions, being ten minutes. The system was then left for twelve hours, when by additions of 4 oz. at intervals of a few minutes the weight sustained was increased to 6 lbs. 4 oz. Eleven hours later this was further increased to 7 lbs. 6 oz., and two hours afterwards, to 8 lbs. 2 oz.

A still smaller electro-magnet, weighing with its coils 5 oz., and having an armature consisting of a very thin slip of soft iron, when excited by one of the bichromate cells, could not be made when in closed circuit to sustain 1½ lb. at the moment of breaking the voltaic circuit. It, however, sustained 1 lb. with ease. The latter weight was therefore suspended, and the cell wires removed after the closed magnetic circuit was completed. By successive additions of 2 oz. weights at short intervals of time (five minutes to ten minutes each), this small magnet could be made to sustain 2 lbs. 2 oz., but the addition of 1 oz. beyond this weight at once separated the armature and magnet. It was thought that a longer interval of time should, as in the former instances, enable the magnet to sustain a still greater weight. It was therefore brought into closed circuit, as before, and made to sustain 2 lbs. 2 oz. in the manner just related, and was thus left for twelve hours. Successive additions of 2 oz. were then made to the hanging weight until it reached 2 lbs. 14 oz. Twenty-four hours afterwards, 4 oz. more were added, bringing the entire weight suspended to 50 oz.

This small, soft iron magnet which, at the instant the voltaic current was withdrawn, was totally unable to sustain five times its own weight, was thus, by gradual growth of its magnetic force, enabled to hold ten times its own weight.

(To be continued.)

THE ELECTRIC DISTANCE MEASURER OF M. G. LE GOARANT DE TROMELIN.

THE question of the rapid measurement of the distance separating a moving object from a point of observation, has often been considered by various inventors. The problem resolves itself into this: There being two given points of observation, O O′, separated by a distance of say 1,200 metres, to find immediately, and without calculation, the distance of a movable point, N (see fig. 1), from the observatory, O. If O O′ represents the base of 1,200 metres, and O A the distance separating the limit, L, of the centre of rotation of the pointer, A *a*, it is evident that if A *a* is parallel to O′ N, the triangles, O *n* A and O N O′, being similar, *n* O will represent on the table, T T, the distance of O from N on the same scale that O A bears to O O′.

This being granted, suppose that from the two observatories, O O′, the telescopes, L and L′, are turned towards the point, N; then if by electrical means we cause the pointer, A *a*, to move always parallel to the telescope, L′, the two similar triangles, of which we spoke, will always be automatically formed, and the point of intersection of the pointer, A *a*, with the graduations, R, engraved on the telescope, L, and which are graduated to the scale of $\frac{O\,A}{O\,O'}$ will give at once, by a direct reading, the distance, O N, which is required.

In order to obtain parallelism between the telescope, L′, and the pointer, A *a*, let us suppose a toothed sector, S, to be fixed to L′, and made movable by means of a tangent screw, V, turned by a handle, M.

The telescope, L, and the pointer, A *a*, are set parallel once for all when the instrument is adjusted. A wheel, P, fixed to the axis, *b b*, of the tangent screw, and provided with an interrupter, I, can produce a number of interrupted currents, so that the escapement of a receiver, regulated by the wheel P, causes the pointer, A *a*, to follow the angular movements of the telescope, L′.

This principle has been effected by various persons; the object aimed at has been the same, but the means by which they have been arrived at are very different.

M. Siemens, well-known by his electrical inventions, has employed the armature which bears his name to effect this result.

On the axis, *b b*, he placed a multiplier wheel, connected with his armature, which turned between the poles of a powerful magnet.

By making the sector, S, turn, he produced at the same time a rotation, more or less rapid, of the armature, which produced reversed induced currents at each half revolution. These currents, transmitted to the receiver, O, constituted a motive force which caused the movement of the needle, A *a*, by means of a system of propelments, driven by an armature oscillating between the branches of an electro-magnet, polarised by a magnet in V.

This system was, as is evident, the application of the *transmission* of force to a distance by the magneto-electric machine which M. Siemens had invented.

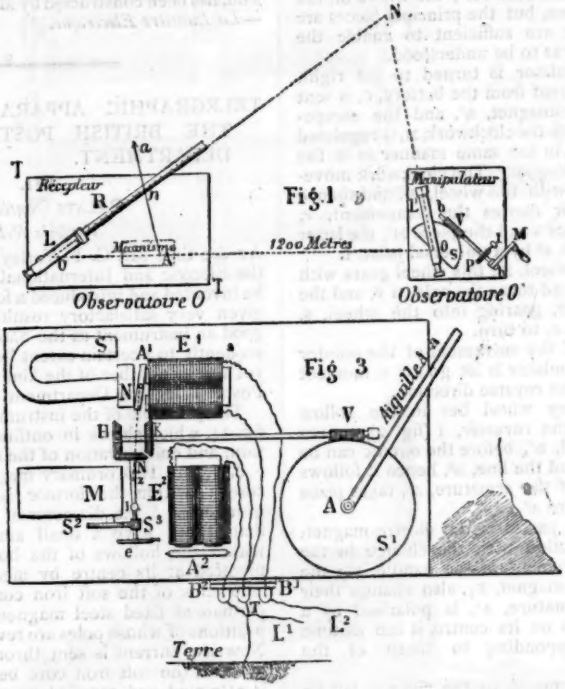
Although ingenious, this system possessed a great defect; in fact, it was impossible to produce a sufficient current without exerting considerable manual exertion, and this was aggravated by the multiplying power of the wheel work. If the manipulator was turned slowly, the currents induced had not sufficient power to move the pointer, which was nearly a metre in length. If the apparatus was turned too quickly, the number of currents transmitted was so considerable that the propelments did not respond at all in consequence of the inertia of the long pointer, A *a*. In any case the motive force was so slight that the wind alone was sufficient to prevent the pointer moving, and consequently parallelism from being preserved.

This system was tried for some time at Brest, and had to be given up.

We have spoken at some length about this *telemeter*, because it is one of the first applications of the transmission of force to a distance, and because it was in France that it was first applied; in fact, because it had features distinct from similar forms of apparatus.

The inconveniences which we have pointed out do not exist in the telemeter of M. de Tromelin. The electricity being only used for regulating an escapement driven by clockwork, it is evident that the motive force can be sufficiently consider-

able to effect the object aimed at. The problem to be solved is that of the movement of the pointer, A *a*, in the two directions. It is necessary that the observer, having followed a particular point with



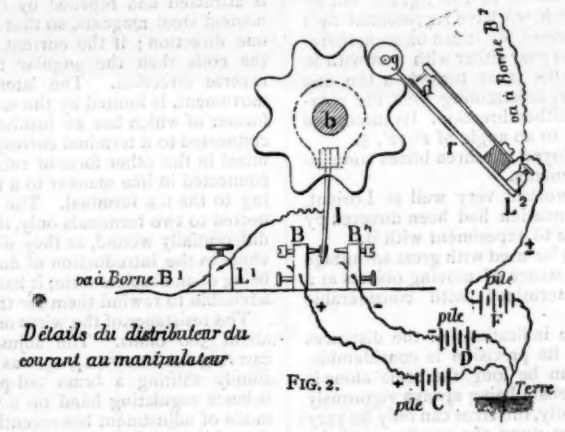


FIG. 2.

the pointer in one direction, shall be able to follow any other point by using the pointer in the reverse direction.

Description.—The manipulator is made as shown by fig. 1; fig. 2 shows details of the same. As can be seen, the wheel, P, has 8 cams, which, by raising the jockey wheel, *g*, during the rotation of the former, produces at *d* interruptions of the current given out by the battery, F, and which flows to line, B. The spring, *r*, is sufficiently strong to cause the jockey wheel, *g*, to lie in the hollow of the cam wheel when the handle which turns the wheel round is left to itself. A reverser, I, mounted friction tight on the axis, *b*, allows either the positive

pole of the battery, C, or the negative pole of the battery, D, to be in connection with I, according as the cam wheel is turned in the one direction or the other, and thus causes either a positive or a negative current to flow out to the line-wire, B'.

Fig. 3 represents the receiver; the whole of the wheels are not shown, but the principal pieces are indicated, and they are sufficient to enable the action of the apparatus to be understood.

When the manipulator is turned to the right, for example, the current from the battery, C, is sent through the electro-magnet, E^2, and the escapement, *e*, connected with the clockwork, M, is regulated by the armature, A^2, in the same manner as is the A B C telegraph of Breguet. The clockwork movement being geared with the wheel, S^2, and thence with S^3, which latter carries the escapement, *e*, tends to turn the piece I and the piece M^2, the latter being connected with S^3 by a universal joint, L.

On *z* is the bevil wheel, N; this wheel gears with the bevil wheel, H, and turns the axle, H V, and the latter by the screw, V, gearing into the wheel, S, causes the pointer, A *a*, to turn.

If the direction of the movement of the pointer is changed the manipulator is let go for a moment and then turned in the reverse direction.

Now, as the jockey wheel lies in the hollow of the cam wheel, the reverser, I (fig. 2), moves over to the terminal, B'', before the circuit can be closed through L^2 and the line, B^2, hence it follows that the movement of the armature, A^1, takes place before that of armature A^2.

The current which passes in the electro-magnet, E_1, changes its direction with the change in the direction of the movement of the handle, M; the poles of the electro-magnet, E_1, also change their polarity. As the armature, A^1, is polarised by a magnet and oscillates on its centre, it can assume two positions corresponding to those of the reverser, I.

This armature, A^1, moves to the right or left by means of a lever, which we have represented by a dotted line, the bevil wheel, N; it can be seen, therefore, that the latter can gear either with H or with K, according as the handle, M, is turned in the one direction or the other, determining thus the rotation of the pointer in either direction. Its successive movements are equal to an angle of 1° 52", 5.

The batteries employed are three boxes containing six Leclanché elements.

This system has worked very well at Lorient, where a Marine Commission had been directed by the Minister of Marine to experiment with it.

The instrument can be used with great advantage in forts, so that the distance of moving objects at a distance can be determined with considerable accuracy.

The rapidity of the indications of the distances cannot be surpassed; its precision is considerable, since the base line can be long, the scale alone is reduced. The parallelism being always vigorously maintained automatically, the error can only be very little, being dependent upon the smallness of the possible angular movement of the pointer, and, as has been pointed out, these movements are very small.

The channels defended by Whitehead torpedoes can also utilise it with advantage, since, in this special case, the velocity of the moving ship could be determined, so that the routes of the torpedo and the moving ship may cross at the right moment.

This ingenious apparatus, which has been an object of favourable report by the Marine Commission, has been constructed by M. Dumoulin-Froment. —*La Lumière Electrique.*

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

VII.

RELAYS (*continued*).

Varley's Relay.

AT the time Mr. C. F. Varley was in the service of the Electric and International Telegraph Company he invented and introduced a form of relay which has given very satisfactory results. Although not so good an instrument as the *Standard* Relay, and consequently to a certain extent being an obsolete form, yet a large number of the kind are still in use in the Postal Telegraph Department.

The principle of the instrument will be seen from fig. 34, which shows in outline, a plan, side elevation, and end elevation of the arrangement.

C, C_1, are two ordinary magnet bobbins without cores; within the former is placed a long soft iron core, *b b*, the diameter of the latter being such that it can have a small amount of lateral play within the hollows of the bobbins. This core is pivotted at its centre by means of an axle, *a*, *a*. The ends of the soft iron core play between two permanent fixed steel magnets, M, M_1, the relative positions of whose poles are reversed to one another. Now if a current is sent through the wire on the bobbins, the soft iron core becomes magnetic and is attracted and repelled by the poles of the permanent steel magnets, so that it turns on its axis in one direction; if the current is reversed through the coils then the angular movement is in the reverse direction. The lateral play, or angular movement, is limited by the screw stops, S_1, S_2, the former of which has an insulated tip; the latter is connected to a terminal corresponding to the M terminal in the other form of relays; the bar itself is connected in like manner to a terminal corresponding to the L z terminal. The coils, C, C_1, are connected to two terminals only, these relays not being differentially wound, as they were constructed previous to the introduction of duplex telegraphy, and being of an obsolete form, it has not been considered advisable to rewind them for that purpose.

The resistance of the wires on their coils averages about 300 ohms. The adjustment of the piece carrying the screws, S_1, S_2, was formerly effected by simply shifting a brass tail-piece similar to the balance regulating hand on a watch. This rough mode of adjustment has recently been improved by the addition of the ordinary adjusting screw employed in the other form of relays; it is difficult to understand why a screw adjustment was not fitted in the first instance.

The general form of the Relay is seen from fig. 35, the glass shade which covers the instrument being normally removed.

FIG. 34.

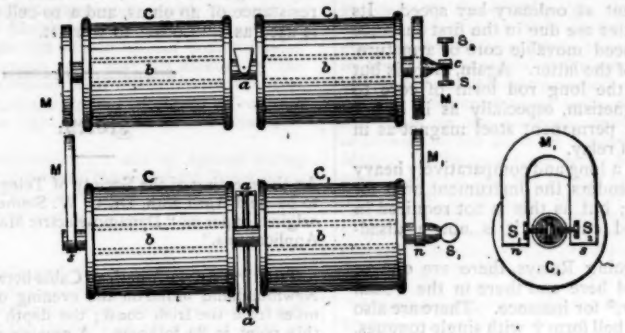


FIG. 35.

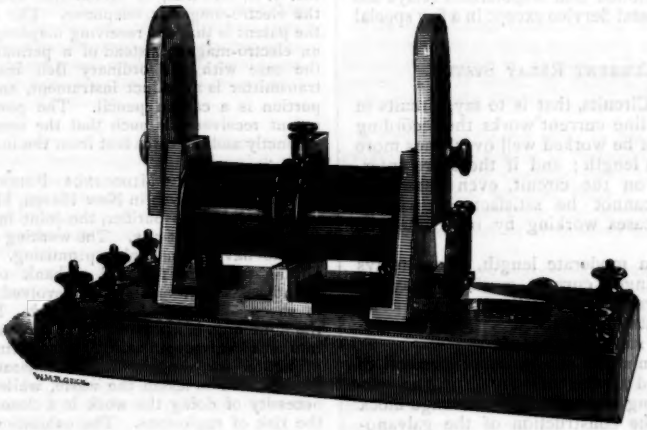
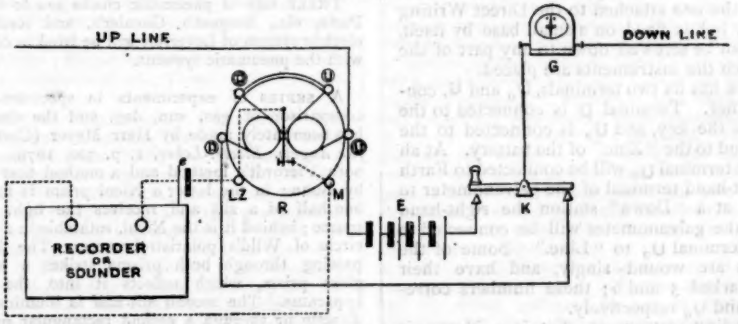


FIG. 36.



Although a somewhat bulky and clumsy-looking form of instrument, the Varley Relay is a very good working apparatus; it will work well with 1 milliweber of current at ordinary key speed. Its good working qualities are due in the first instance to its perfectly balanced movable core or armature, also to the rigidity of the latter. Again, there is but little tendency for the long rod form of core to retain residual magnetism, especially as it is not polarised by a large permanent steel magnet as in the Siemens' form of relay.

The inertia which a long and comparatively heavy rod must possess renders the instrument unfit for high-speed working; but as this is not required in ordinary key-worked currents it is not a disadvantage.

Besides the foregoing Relays, there are one or two other forms used here and there in the Postal Service—the Theiler,* for instance. There are also a few of the Bright's bell form † with single tongues. The number of these miscellaneous instruments is, however, so small, that they can hardly be considered as forming part of the general apparatus, and they will not, therefore, all be alluded to.

It may be mentioned that *un*polarised relays are not used in the Postal Service except in a few special cases.

SINGLE CURRENT RELAY SYSTEM.

Direct Writing Circuits, that is to say, circuits in which the direct line current works the recording instrument, cannot be worked well over lines more than 100 miles in length; and if there are intermediate stations on the circuit, even lines of a shorter length cannot be satisfactorily worked direct; in such cases working by relay must be resorted to.

For circuits of a moderate length, where relays are necessary, single current working may be adopted. The arrangement of the apparatus at an "Intermediate" station, worked on the single-current system, is shown by fig. 36.

G is a galvanometer, the *right*-hand terminal of which is connected to the "Down" line, the left-hand terminal being connected to the hinge block of the key, K. The construction of the galvanometer possesses no peculiarities; the instrument, in fact, is very similar in construction to an ordinary single-needle dial. The key, K, is similar in construction to the one attached to the Direct Writing instruments, but is fixed on a small base by itself, so that it can be screwed down to any part of the desk on which the instruments are placed.

The relay R has its two terminals, D_0 and U, connected together. Terminal D is connected to the back stop of the key, and U_0 is connected to the "Up" line and to the "Zinc" of the battery. At an "Up" station terminal U_0 will be connected to Earth and the right-hand terminal of the galvanometer to "Line," and at a "Down" station the right-hand terminal of the galvanometer will be connected to Earth and terminal U_0 to "Line." Some of the older relays are wound singly, and have their terminals marked 5 and 6; these numbers correspond to D and U_0 respectively.

The Recording instrument, if it is a Morse, is similar in construction to the Direct Writer apparatus, only, of course, it is not provided with a key or galvanometer; the coils are wound to a resistance of 40 ohms, and a 10-cell Daniell battery is used as a "Local" to work it.

* *Telegraphic Journal*, Sept. 1st, 1877.
† *Telegraphic Journal*, Feb. 15th, 1880.

Notes.

AT the meeting of the Society of Telegraph Engineers, to be held April 28th, Dr. C. W. Siemens will read an original paper on "Dynamo-electric Machines and their Applications."

THE 1877 Anglo-American Cable between Ireland and Newfoundland broke on the evening of April 2nd, 36 miles from the Irish coast; the depth of the water at this point is 80 fathoms. A repairing ship has been despatched to restore communication.

SOME experiments have been tried at Melbourne, Australia, with a new patent telephone, invented by Mr. J. E. Edwards, of Melbourne, and called by him the electro-magnetic telephone. The chief feature of the patent is that the receiving diaphragm is moved by an electro-magnet instead of a permanent one, as is the case with the ordinary Bell instrument. The transmitter is a distinct instrument, and the principal portion is a carbon pencil. The power of the new patent receiver was such that the sender's voice was distinctly audible three feet from the instrument.

THE ELECTRIC MIDDLINGS PURIFIER.—A public exhibition was given in New Haven, March 13, of the electric middlings purifier, the joint invention of two young men of that city. The working of the device is said to have been highly promising. Over the wire bolting cloths are placed a bank of hard rubber cylinders, which are slowly revolved against strips of sheep skin and thus electrified. To these rollers the light bran is attracted, to be mechanically brushed into a proper receptacle. This substitution of electric attraction for the air blast in separating bran from flour is said to lessen the waste, while it obviates the necessity of doing the work in a closed chamber and the risk of explosions. The exhibition was made in an open room, and there were neither dust nor waste.—*Scientific American.*

THREE sets of pneumatic clocks are to be tried in Paris, viz., Breguet's, Garnier's, and Redier's. An electric system of Leverrier will be tried in competition with the pneumatic systems.

A SERIES of experiments in spectrum-analytical comparison of gas, sun, day, and the electric light has been lately made by Herr Meyer (Carl's *Zeitsch. für angew. Electr.-Lehre*, 1, p. 320, 1879). He used both Vierordt's method and a method first suggested by Bohn; in the latter a Nicol prism is fixed before one half of a slit and receives the light from one source; behind it is the Nicol, rotatable in a graduated circle of Wild's polaristrobometer. The light beam passing through both prisms strikes a rectangular glass prism, which reflects it into the spectrum apparatus. The second slit-half is illuminated either directly or through a second rectangular prism from the second light source. The numbers show that the brightness of the colours in the gas-spectrum, compared with that in sun or daylight and the electric

light, steadily decreases from the red to the violet end of the spectrum. As sunlight is considerably brighter in the middle parts of the spectrum than the electric light, the latter should appear yellow with the former; and in a Ritchie photometer the surface illuminated by the electric light did indeed appear yellow like an orange, in comparison with that illuminated by the sun. Another interesting fact elicited is that in daylight there is comparatively more red and yellow, and less blue and violet light than in sunlight.—*Nature.*

TELEPHONIC communication will be opened during the summer months between the top of the Drachenfels and Königswinter, on the Rhine. The apparatus will be fitted up by the German Postal and Telegraphic Department.

AT a recent meeting of the Scientific Committee of the Royal Horticultural Society, a number of specimens of flowers and vegetables were exhibited which had been grown under the influence of the electric light by Dr. Siemens. The specimens were of five descriptions, viz., pots of seedling mustard, buds of the Countess of Oxford rose, spathes of Calla Æthiopica, and pots of carrots. The first specimens grew with equal vigour when exposed either to the electric or to solar light, those exposed to the electric light, however, were the darkest in colour. The two second descriptions grew with greater vigour when exposed to the electric light. The carrots grew equally well under either conditions, but when exposed to both the electric and solar lights they flourished more vigorously.

THE ELECTRIC LIGHT IN INDIANA.—A contract for a 10,000 candle-power electric light, to be placed in the dome of the County Court House, at Wabash, Indiana, and intended to light that city, has been let to the Brush Electric Light Company, of Cleveland, Ohio, for 1,800 dols. The agreement provides that, should the light prove unsatisfactory, the city shall be at no expense. A guarantee for a perfect light has been given by the company.

THE telegraph line between Fort Beaufort and Natal is to be duplicated, this addition having been found necessary in consequence of increase of work arising from the messages arriving by the Cape Cable. The existing line has considerable local traffic on it, as it has several stations on its circuit.

TELEGRAPHIC RATES.—The revised tariff for telegrams, which took effect on the 1st of April, is as follows:—Austria, 4½d. for each word; Belgium, 2d.; Denmark, 4d.; France, 2½d.; Germany, 4d.; Greece, 7½d.; Holland, 3d.; Hungary, 5d.; Italy, 5d.; Norway, 4d.; Portugal, 6½d.; Russia in Europe, 9d.; Spain, 6d.; Sweden, 5½d.; Switzerland, 4d.; Turkey in Europe, 8d.

THE MEXICAN TELEGRAPH COMPANY.—The Mexican Telegraph Company has been organised under the laws of New York, for the purpose of establishing telegraphic communication with Mexico and Central and South America. Arrangements have been made by the company for acquiring a concession granted by the Mexican Government, by which the control of all foreign messages to and from places in Mexico, south of a line 156 miles south of the boundary line of the United States, is secured *exclusively* for the term of 50 years, and the right of establishing and working telegraph cables between the United States, Central and South America, *via* Mexico, is secured for 50 years, during which time the Government of Mexico binds itself not to grant to others like privileges. Negotiations are in progress for the extension of telegraphic communication to Guatemala, San Salvador, Honduras, Nicaragua, Costa Rica, Panama, U. S. of Columbia, Ecuador, connecting exclusively with the lines of this company, and the established lines from Payta, Peru to Chili and Brazil, on terms very beneficial to the company. The present undertaking of this company will consist of about 500 miles of submarine cable (with no land lines), which will begin on the southern coast of Texas, and be continued to the cities of Tampico and Vera Cruz, Mexico, connecting there with the Mexican Government lines built over the railway to the City of Mexico, from which point 7,300 miles of wire extend to all important cities of that Republic. Mr. James A. Scrymser is President and Senor Don Ramon G. Guzman, Resident Vice-President for Mexico.—*Journal of the Telegraph.*

A TELEPHONIC exchange is to be established in Madrid.

A CONTRACT for laying a submarine cable across the Gulf of Mexico, connecting the United States with the Mexican Republic, has been approved by the Mexican Congress.

THE publication mentioned in the leader of the present number as being conducted in the interest of Electro-metallurgy is entitled, "The Electro-Metallurgist," and is issued by Messrs. J. A. Brook and Company, of 282, Strand.

A NEW paper, stated to be in the interests of telegraphy, has been started in Philadelphia. It is entitled *The Magnet*, and contains much that is interesting or amusing, but we note little of scientific matter. Apparently the intention is to entertain rather than to instruct. We wish its editor every success.

THE French newspaper *La France* says:—"The members of the jury of painting for the forthcoming Salon have drawn up a protestation against the employment of the Jablochkoff light."

THE MAGNET IN MILLING.—The truth is, that the introduction of magnets as a grain-cleaning agency opened the eyes of millers to a few facts of which they had been ignorant before. They had been perfectly cognisant of the damage done by wire in wheat, but no one expected such a revelation as the use of magnetic separators gave us all. Most of us knew that the magnets would show that wire existed where its presence was never suspected; but who would have looked for such a collection of metallic odds and ends as these separators bring to light? In the course of a day a large merchant mill will take from its wheat, by means of magnets, a miniature junk shop. You will find everything represented, from tenpenny nails down to bits of iron as small as a pin-head. How all of it got into the wheat is a mystery; but one thing is certain, that much of this iron must formerly have gone to the burrs and bolts, and if the wire binder had never been invented magnetic separators would find a useful place in every mill. But the wire binder has come to stay. Revolutions do not go backward, and it is not at all likely that the farmer will ever again rely upon "tramp" labour in harvest after once having had his wheat gathered by one of these binders. Therefore we must expect wire in our wheat along with nail-heads and other rural products. So far, the magnet is the only effective means discovered by which the miller can remove wire from his wheat, and

therefore, the magnet and magnetic separators are probably as much of a permanency in milling as the wire binder is in agriculture.—*American Miller.*

BY a recent improvement, M. Chambrier, of Charleville, claims to have increased the power obtainable in electro-magnets. The new form of magnets have enlarged attracting surfaces. In one arrangement the poles of the magnets are made hollow, and in the cylindrical cavity so formed, which is a few millimetres in depth, a small piece of copper or other non-magnetic metal is inserted. The armature is so channelled with annular cavities as to fit into these hollows, the copper in the latter preventing magnetic contact. The increased pull between this form of armature and the hollowed cores is said to be due to a similar action to that which causes a bar of iron to be sucked into a solenoid through which a current is passing. M. Chambrier states that an increase in pull of over 50 per cent. is obtained by this form of magnet and armature.

A NEW YORK correspondent of the *Standard* says: "That of the 200 paper carbon lamps tried by Mr. Edison, only two remain at present undestroyed. A professor of Harvard University has sent him 50 specimens of fibres to test for the carbon horse-shoes instead of the paper formerly used. Mr. Edison finds manilla is the best of them for his purpose." Amongst those who have the best opportunity of judging what he has done, or is likely to do, little hope seems to remain of his ultimately attaining success with his incandescent lamps.

MR. BARLOW, of Doctor's Commons, kindly forwards us the following notes relating to Patent Laws:—

U.S. AMERICAN PATENTS.—As an American patent expires at the same time as the prior foreign patent (for the same invention) having the shortest term, applicants for patents must, according to section 4,887 of the "Revised Statutes," set forth in the oath accompanying the petition and specification, either the date and reference of prior patent, or that no such other patent has been obtained or applied for, according to the case. As a U.S. patent is granted for a term of 17 years without annuity or further payment, it would appear advisable for inventors to first secure their patent rights in that country, before securing other foreign patents.

AUSTRO-HUNGARIAN PATENTS.—Another change in Patent Laws which is of importance to inventors is that in Austro-Hungary, whereby the procedure is much simplified, viz.:—The Austrian Ministry of Commerce have decided that henceforth *Foreigners* applying for Austro-Hungarian patents are not required to furnish a legalised copy of prior "*Foreign Patent*," nor will it be necessary to prove to the authorities that the Austrian patent has been worked within the prescribed term, as has hitherto been the case, although the proper working must not be neglected.

TRADE MARKS IN SWITZERLAND.—The Swiss Federal Council has passed a Trade Marks Registration Act, by which trade marks, having been properly registered abroad, will receive full and complete legal protection in Switzerland. *Proprietors of old trade marks should apply for registration before 9th April*, 1880, or as soon as possible afterwards, in order to secure their priority.

MR. CYRUS W. FIELD is said to intend starting shortly for a tour round the world. He has worked hard for 45 years, and thinks he has earned a right to some pleasure.—American *Operator.*

M. FROMME finds that a Grove's battery is most efficacious when the nitric acid contains 40 per cent. of water; the "strength" of Bunsen's decreases with the concentration of the acid; and that of Daniell increases with the concentration of the sulphate of copper solution.

TOUGHENED glass M. Ducretet finds to be an excellent material for leyden jars, as it offers a greater resistance to a disruptive discharge than ordinary glass. In consequence of this fact, leyden jars can be made comparatively thin, and so have a greater capacity without the risk of the dieletric becoming pierced by a discharge.

CARDBOARD covered with a film of collodion may be used with advantage in the place of the ordinary resinous cake or ebonite plate arc for the "electrophorous." This discovery, made by Professor Borlinetto of the University of Padua, is said to yield excellent results, the sparks obtained from the apparatus being decidedly longer than those given out with the ordinary exciting plate.

A CORRESPONDENT to a contemporary states that he has successfully deposited bismuth on iron and steel from a solution of the ammonia-citrate of that metal. The solution may be prepared as follows:—Dissolve metallic bismuth in strong nitric acid. To this solution add ammonia or carbonate of ammonia as long as any precipitate occurs. Next, filter and wash this precipitate and dissolve it in a strong hot solution of citrate of ammonia. This solution must be used hot (at a temperature of 150 to 180 degrees Fah.), with an anode of bismuth about the same size as the cathode, and a battery of about a couple of Daniell's cells. The cathode may be easily cast in a shallow cardboard tray, and should be ¼ in. thick, and have a copper wire cast in it for connection. Two ounces of bismuth will furnish an anode of 4 square inches. He has also used the sodio-potassio-tartrate of bismuth in solution with the same success, but he deems the above equal in results and easiest made.

CHASSE'S MULTIPLEX TELEGRAPH. — For some months a Frenchman, named Chasse, has been promulgating the most astonishing claims with regard to an alleged new process of telegraphing, by means of which an indefinite number of messages might be sent simultaneously in opposite directions over a single wire. A few days ago practical telegraphers were invited to witness a demonstration of the process at the inventor's workshop in Hartford, Conn. There were eighteen telegraphic instruments at each end of the room, all connected with a single wire, supposed to represent a cross country line. Eighteen messages were sent each way, all at once, apparently through the single wire. Among the witnesses was Mr. William Hadden, of the American Union Telegraph Company, who noticed that the insulated connecting wires were neatly fastened to the wall by double-pointed carpet tacks. On pulling one out he found that beneath each tack the covering of the wire had been neatly cut away, and an ingenious system of false circuits established by fine wires leading from the tack legs. The supposed cross-country wire was a sham, and the too promising multiplex telegraph a clever cheat.—*Scientific American.*

ROUMANIA has given her adhesion to the International Telegraphic Convention of 1879, and the new tariff will come into operation in that country on April 1st.

THE material known as Parkesine, Celluloid, or

Xylonite, is now manufactured by the "British Xylonite Company." This material has considerable electrical insulating properties, and may be used with advantage in many cases where ivory or ebonite are at present exclusively employed. Although the material was introduced several years ago, it has only recently been so far improved in manufacture as to become a useful material for electrical and other purposes.

THE NEW SAWYER ELECTRIC LAMP.—"This lamp," says the *Scientific American*, "based upon the incandescence of a pencil of carbon immersed in nitrogen gas, is in no way different in principle from the Bouliguine or the old Sawyer-Mann lamp exhibited some years ago. The pencil is contained within a globe two inches in diameter and ten inches high, sealed at the bottom by means of a cement, which, while adhering perfectly to the glass and metal, is sufficiently elastic to compensate for the unequal expansion of the two. It softens only at a temperature of 500° Fah. The globes are charged by the process invented some time ago by Thomes B. Stillman, which is so simple in its details and so rapidly operated that a single workman can prepare fifty lamps per hour at a cost of about thirty cents, in such a manner that according to Stillman's calculation, the amount of atmospheric air remaining is only an infinitely small fraction of the normal quantity. The cost of the nitrogen is stated at eight-tenths of one cent, and that of its purification as one and one-fifth cents; the total cost of recharging a lamp, when the nitrogen is exhausted or becomes mixed with air, being, inclusive of the wages of the workman, two and three-fifths cents, against a cost of seventy cents for the process usually employed. The carbon pencil, seven inches in length and about three thirty-seconds of an inch in diameter, is fed upward as fast as disintegration takes place at the point of contact, by means of a regulator, which will be substituted by an automatic feeder as soon as the arrangement can be perfected. Mr. Sawyer says that one of these pencils, used for five hours a day, will last at a minimum calculation from his experiments, not less than ninety days, and, at a maximum, for two years. The cost of the pencil is a trifle less than two cents, and the cost of replacing and recharging with nitrogen nine and three-fifths cents. The bag of sodium and the large spiral conductors at the base of the carbon, which were distinguishing features of the Sawyer-Mann lamp exhibited about a year ago at No. 94, Walker-street, have been discarded. Two small steel rods take the place of the latter. The globe, which is not unlike the chimney of an ordinary kerosene lamp in general appearance, is imbedded in a nickel-plated base, which may be highly ornamented or not, according to the taste or means of the user. Photometric tests, it is said, have been made with a Sugg photometer, such as is used by the gas companies for the same purpose, and each light was registered as equal to twenty-seven and five-tenths standard candles, or a little more than twice the value of a five-foot gas burner, which usually registers from ten to twelve standard candles. Mr. Sawyer claims that his system of distribution is entirely novel and original, but declines for the present to give a description of it, his patents not having been as yet secured. The regulator, we are told, is based upon the plan used by the old Berlin house of Siemens Brothers, by which only such a volume of current is supplied as is necessary to overcome the resistance. The light is readily toned down to a glimmer by turning a button in the wall. In its optical properties this light is much like gas. It is yellow, steady, and soft, and consequently not irritating to the eye. It has none of the blue rays incident to the voltaic arc arrangement, and the shadow cast by intervening objects is softened and mellowed at the margin. For practical purposes it is intended that the power of each lamp shall not exceed that of two ordinary gas jets."

[It is stated that seven lamps are operated upon one circuit worked by four horse-power. The economy of this system does not appear to be marvellously great. Seven lamps of 27½ standard candles each, or 192½ candles in all, for four-horse-power, is not a very wonderful achievement.—ED. TEL. JOUR.]

Review.

Instructions for Testing Telegraph Lines, and the Technical Arrangement of Offices. BY LOUIS SCHWENDLER. Vol. II. London: Trübner & Co., Ludgate Hill.

THE object of this second volume of testing instructions is the supply of testing information to the officers in charge of telegraph stations where the testing has to be made with less elaborate instruments than the Wheatstone bridge or Differential galvanometer, the use and theory of which were explained in the first volume. The instrument employed for the comparatively simple system of testing is a tangent galvanometer, provided with accessories in the shape of a few resistance coils, a switch, &c. The instrument has three distinct deflecting coils, viz., a thick brass ring, which is used for measuring so-called "quantity" currents; a thick copper wire coil consisting of a few convolutions, having a total resistance of about one ohm; and a third coil formed of a large number of convolutions of thin wire, having a total resistance of about 100 ohms. In connection with the thin wire coil are three resistances of 100, 1000, and 2,000 ohms respectively, which can be put in circuit in the ordinary way by means of plugs, when required. The thick wire coil has also three resistances in connection with it, of 1, 20, and 200 ohms respectively.

In describing the instrument, Mr. Schwendler explains a fact, which, we believe, was first pointed out and proved by Mr. H. R. Kempe in the number of this Journal for July 1st, 1877, viz., that the tangent galvanometer is most sensitive when its deflection is equal to 45°.

As regards the accuracy with which a test can be made, Mr. Schwendler draws attention to a point which is almost obvious, but one which, as far as we are aware, has never been put in print before, namely, that in measuring a resistance with the tangent galvanometer by the simple device of observing two deflections with different known resistances in the circuit, it is very essential that the values of the known resistances should be in proportion to the value of the resistance whose value is being measured. Thus, if we are measuring a resistance whose value we know to be a few ohms only, and we first take a deflection with, say 1,000 ohms in circuit, and then another deflection with 2,000 ohms in circuit, theoretically from these two measurements it is possible to determine the exact value of the unknown resistance by a simple formula, but, practically, we may make an error of several hundred per cent., simply because the small unknown resistance has practically no influence upon the measurements

made, it being swamped as it were by the larger resistances in the circuit. We know many instances in which the want of an intelligent appreciation of the simplest tests leads to most absurd results being obtained; thus, for instance, a very common test for the resistance of a battery is that of joining the latter in circuit with a resistance coil and a tangent galvanometer, noting the deflection, then increasing the resistance until the deflection representing half the current is obtained, when the resistance of the battery x is obtained from the simple formula

$$x = R - (2r + g)$$

where r is the resistance when the first deflection is observed, R the resistance necessary to halve the current, and g the resistance of the galvanometer.

In measuring the resistance of a battery whose resistance is but 1 or 2 ohms by this method, an unintelligent experimenter is as likely as not to measure his deflections with several hundred, or even several thousand ohms in circuit, and then, on working out the result by the formula, he is surprised to find that the result he obtains is either several hundred per cent. higher than the resistance can possibly be, or the result he obtains has a negative value.

Mr. Schwendler truly remarks that, "Results obtained by experiment have scarcely any real signification, if the tester himself does not adopt some means of checking their accuracy."

In dealing with the questions of accuracy of measurement, the subject has been treated with great advantage by simple reasoning, without any elaborate mathematical proofs.

The chapter on Batteries is very full and exhaustive, though dealing only with the kind in use in India, viz., the Minotto. The number of cells of this kind in use in that country is over 10,000.

Mr. Schwendler makes a remark with reference to the testing of batteries, but which applies to all testing, which has a very great deal of truth in it, viz., that "Instead of testing being considered as a means of arriving at practical results, it has been regarded as the work itself, and as entailing no benefits whatsoever. If testing be executed with so little physical spirit and true understanding of its purposes, it would be better to dispense with it altogether."

Besides the testing of lines and batteries, every instrument used should be tested to see that it will satisfy the ordinary working conditions. The "Range test" to which the Indian instruments are subjected is for the purpose of determining the relative values of the weakest and strongest currents with which an instrument will work without the given adjustment of the latter being required to be altered. The range being a decreasing function of the speed with which the instrument is worked; the working range is that required at the greatest key speed. The range required in the Indian relays is found to be equal to four, as the working currents never exceed 8 milliwebers, and the relay will not work safely with less than 2 milliwebers.

A form of relay is described, the invention of M. D'Arlincourt, which is used successfully in India; but its advantages are by no means obvious. That it should be successfully worked is hardly a sufficient recommendation for its use, but if it exceeds in sensitiveness and reliability the existing forms of relays its advantage is clear; but we are inclined to think that this has not been proved, as the gain in one direction is neutralised by a corresponding loss in another, and thus, although the D'Arlincourt Relay possesses decided *novelty*, it does not possess decided practical advantages over existing forms of relays. Inventors seem continually to forget that something more than novelty is required in new inventions.

In the portion of the work dealing with the "Charge and Discharge of Telegraph Lines" several ingenious arrangements are explained for effecting this object in working long lines. The effect of the discharge in such lines is stated to be severely felt in India; but in America, where we fancy equally long lines are worked, we are not aware of any such discharging arrangements being used or considered necessary.

The action of electro-magnetic shunts is well understood and as easily comprehensible, but contrary to what might be expected, it has been found by Mr. Schwendler that a condenser placed in the same position as an electro-magnetic shunt effects the same object, though one would think that a reverse action would take place.

The reading instruments in use in India are the sounder and the ink-writer, the latter form of instrument as manufactured by Messrs. Siemens is so fitted that a broken mainspring can be replaced with great ease, there being no occasion for taking the whole instrument to pieces.

A great point in Mr. Schwendler's second volume of his testing instructions is, that it contains little else than thoroughly practical and useful matter, which was hardly the case with his first volume. Taking the two volumes as a whole they are very creditable productions, and should certainly be added to every electrician's library. They are more especially useful for those engaged in the Indian Telegraph Service, indeed, if they are to be regarded as instructions for general use in other services we are afraid that they will not prove of much value, and it is a pity that Mr. Schwendler did not make himself better acquainted with the real wants of other telegraph administrations before offering his work as a supply to this want. He would have done better if he had issued his work without recommending it for this purpose.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—In a recent number of *Engineering*, Mr. Ladd claims for the "Brush" system of electric light "absolute steadiness." As invited by him, a scientific friend and myself visited the Great Eastern Station the other evening, and we were much disappointed to find anything but a *steady* light, one also producing a very unpleasant and ghastly illumination. The globes surrounding the light showed on one side a space covering one-third of the periphery, of a dirty brown colour, caused, very likely, by the shadow of the carbons or regulators. To our mind the station was

lit far better by gas; the height at which the lamps were hung counteracting any good effect a brighter light might have given. I *make* these observations simply because Mr. Ladd must understand that many who know some little regarding the various systems are not quite so much satisfied with the "Brush" as he is, nor think it "sweeps clean."

The "Lontin" lights at the Aldersgate Street Station I visited the same evening, and though by no means steady, were more so than those at Liverpool Street, and gave a brighter and clearer light, with none of that greenish sickly pallor experienced in the "Brush" system.

Yours, obediently,
Junior Carlton Club, Pall Mall. ELECTRON.
April 5th, 1880.

AN AMERICAN OPERATOR.—The standard of insulation of the Postal Telegraph Lines in England is 200,000 ohms per mile in bad weather; if the insulation falls below this standard the line is considered faulty. This standard applies to all the lines worked by the Postal Department, and except in special cases where the lines run through a very smoky manufacturing district there is no difficulty in keeping it up. The *average* insulation of a line is greatly in excess of 200,000 ohms per mile, but no general average can be given, as it varies with the districts through which the lines run.—ED. TELEGRAPHIC JOURNAL.

Proceedings of Societies.

PHYSICAL SOCIETY.—APRIL 10th.

PROF. FULLER in the Chair.

New members—Mr. W. O. SMITH, Prof. JUDD, F.R.S.

A paper on "The Human Eye as an Automatic Photometer," by Mr. WILLIAM ACKROYD, F.C.S., was read. It is difficult to get the value of a very intense light in terms of a weak one, because the relative physiological values of the similarly coloured constituents are unknown. The author's experiments were made to show that the eye itself is a fairly good light measurer. When a "spot" or star of light is looked at from a distance it is seen to emit "rays" or spots of light at all angles. These are due to the structure of the crystalline lens and the lachrymal fluid on the surface of the cornea of the eye. The rays are of various lengths, and are shorter in the first and second quadrants near the blind spots next the nose than on the third and fourth quadrants, a fact probably due to the insensibility of this region. The iris expands and contracts under the stimulus of light independently of the will; and both ires act sympathetically. Now the iris lies between the seats of irregular refraction, and thus any change in the size of the pupillary aperture will be rendered evident by an alteration in the length of the longer rays of a spot or point of light. On this fact is based the use of the eye as an automatic photometer. The sensitiveness of the iris varies in different persons. The author finds that a sperm candle burning 120 grains per hour produces a distinct movement of his iris when fourteen yards distant. In employing the eye as a photometer the author adopts the principle that if the light from one source, A, falling on the eye is capable of producing movement of the iris at a distance, *d*, and the light from a different source, B, is capable of producing the same movement at the distance d', then the relative intensities can be formed from the inverse squares of these distances. To carry this out in practice the observer is in the dark, and an artificial star is placed on a level with the eyes at a fixed distance. Below this is placed the light to be tested in the same plane. While gazing steadily at the star the other light is to be eclipsed and revealed, and the observer is to find a position where the revealing of the second light does not influence his iris, as shown by no apparent shortening of the rays of the star taking place. He then approaches gradually till a second position is reached where the revealing of the second light *does* produce a movement of the iris. The distance between these two positions, *d*, is measured. A third light is now put in place of the second, and the same observations repeated so as to get a second distance, d'. From these distances the relative intensities are calculated. The author's results agree pretty closely with Rumford's photometer; but he found that for some reason the two first observations have to be discarded as too inaccurate. Owing to the sympathy between the two ires these experiments were binocular. This sympathy may prove convenient in constructing an eye-photometer, since one eye can be turned to the light to be estimated while the other is looking at the artificial star. This method of photometry would be too delicate for comparing powerful electric lights unless aided by mechanical means.

Prof. AYRTON then offered an explanation of the experiment shown by Prof. Guthrie at last meeting to the effect that, while flannel rubbed with ebonite was + electrified, and ebonite rubbed with glass was +, flannel rubbed with glass was —.

Prof. AYRTON accounted for this apparent anomaly on the grounds that one or more of the substances was an electrolyte. Glass, for instance, is an electrolyte, and a battery had been made from it. Experiments made by Prof. Perry and himself had shown that in a "pile" made up of divers substances, one or more of which were electrolytes though the rest were metals, the electro-motive force of the pile was equivalent to the algebraical sum of the several "pairs" composing it, but it was *not* equivalent to the electro-motive force of the first and final plates made into a pair. That could not be predicted from the contact electro-motive forces of the elementary pairs. When only metals were employed it could, but not in cases where an electrolyte entered. This same result would apply to Professor Guthrie's frictional experiments.

In answer to Prof. Guthrie's question, whether electrolysis did not come into play in Prof. Ayrton's experiments, Prof. AYRTON replied that it could not operate to a greater extent than in Prof. Guthrie's experiments, as he had used a quadrant electrometer.

Dr. STONE then described a new tonometer devised by Prof. Rudolf König, which he had recently seen in Paris. It consisted of a clockwork working into a tuning-fork which produced no less than 128 escapes per second. To this clockwork, originally invented by an assistant of M. Breguet, and exhibited at the Paris Exhibition of 1856, Prof. König had added a Helmholtz vibration microscope, moved by the clock, and the fork whose vibration number is to be measured is placed vertically in the focus of the microscope. The apparatus is very portable, and no loading of the fork is required.

Prof. HUGHES observed that he had patented a vibrating regulator in 1856.

Dr. GUTHRIE then exhibited an electric machine formed of a collodion disc rubbed with cat's fur and giving negative sparks. The collodion, after a suggestion of Captain Abney, was put on by giving a disc

a coat of collodion, then a coat of india-rubber dissolved in bensol, then a coat of collodion again. Prof. GUTHRIE also showed that an iron cylinder revolving round its longer axis with a current flowing in a wire parallel to it has power to deflect a magnetic needle. Prof. AYRTON stated that he had found the mere rotation of an iron cylinder produce the deflection in question, and therefore thought the current was not required to produce the effect shown.

New Patents—1880.

1286. "Telephones." J. H. JOHNSON. (Communicated by E. Marx, F. Aklem, J. Kayzer, and L. Davis.) Dated March 27.

1295. "Insulating electrical conductors." E. M. ALLEN. (Communicated by A. A. Knudson and F. L. Kane.) Dated March 30.

1328. "Improvements in and relating to telegraphic and telephonic apparatus." W. R. LAKE. (Communicated by E. Davis and P. A. Dowd.) Dated March 31.

1333. "Improvements in or applicable to machinery or apparatus for the manufacture of engine-packing, insulated telegraph wires, or other similar manufactures." G. F. JAMES. Dated March 31.

1339. "A new or improved rotary induction or electric motor." J. C. MEWBURN. (Communicated by W. de Fonvielle.) Dated April 1.

1343. "Improvements in apparatus for the production and application of electricity and of magnetism." J. L. PULVERMACHER. Dated April 1.

1385. "Dynamo-magneto electric machines and electric motors." T. A. EDISON. Dated April 5.

1392. "Improvements in and relating to dynamo-electric machines." W. R. LAKE. (Communicated by H. S. Maxim.) Dated April 5.

1397. "Improvements in electric lamps and in solenoids applicable for their regulation." C. D. ABEL. (Communicated by F. Krizik and L. Piette.) Dated April 6.

1407. "Improvements in electrical conductors and in the arrangement and manner of using conductors for telephonic and telegraphic purposes." O. HEAVISIDE. Dated April 6.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

3164. "Demagnetising iron ships to prevent deviation of the compass." EVAN HENRY HOPKINS. Dated August 6. 6d. Consists in passing a straight powerful permanent magnet, or an electro magnet, held more or less in the angle of the magnetic dip, over the transverse beams supporting the decks. The magnet is passed either from the sides to the centre of the deck, or from the centre to the sides, or from one side to the other, according to the magnetic conditions of the iron to be operated upon.

3207. "Apparatus for reversing electric currents." W. R. LAKE. (Communicated by Count Emile Siccardi.) Dated August 9. 8d. Has for its object a current reversing apparatus or manipulator for use in submarine telegraphy and with cables of any length or resistance. It may also be employed with the devices known as the siphon recorder or the receiving mirror of Sir W. Thomson. Its special purpose is to render the signals always perfectly clear upon these instruments by a constant reversal of current.

3355. "Manufacture of electrodes for the electric light." W. MORGAN-BROWN. (Communicated by Paul Albert Porlier.) Dated August 20. 6d. Consists in replacing carbon electrodes and electrodes with metallic cores by electrodes of an external metallic tube, the combustion of which is slackened by a substance charged within the tube and which is capable of forming with the metal of the tube a combination which is a bad conductor of electricity, and which is constantly reproduced under the influence of the electric current at the same ratio at which it is consumed by the same current. Amongst other substances are named oxide of magnesia, dolomite, or carbonates of magnesia, of lime, and even of baryta and of strontium.

3393. "Telephones." PHILIP SYNGE JUSTICE. Dated August 23. 6d. Consists in holding by mechanism the carbon or other imperfectly conducting medium in the transmitting instrument regularly under pressure, and in causing the action of the diaphragm, under the impulses of the sound-waves, to diminish the pressure thus regularly applied, whereby the resistance of the carbon or other conductor can be reduced and regulated at will, and greater sensitiveness and scope of the electrical indulations produced; and also consists in causing the vibrations of the diaphragm to act through intermediate mechanism, whereby the motion of the said diaphragm is exaggerated and greater effect produced upon the carbon or other medium.

3472. "Compounds for insulating telegraph wires." ALEXANDER WILKINSON. Dated August 28. 4d. Relates to improved compounds or combination of ingredients for insulating and coating telegraph wires, and consists, first, in amalgamating one pound of beeswax, three pounds of white lead, with a proportion of Stockholm tar, and a small quantity of tallow. Second, in repeating this operation. Third, in a plaiting or braiding operation; and, fourth, in passing it through a compound of pitch, ground cork, and bisulphite of carbon, mixed in suitable proportion and brought into a liquid form without heat.

3543. "Electro-magnetic induction apparatus." ROBERT HENLADE COURTENAY. Dated September 3. 2d. Consists of four soft iron or soft steel bars, arranged in a square, so that the ends are respectively in as close proximity to each other as is possible without actual contact. Upon each bar are mounted two or more bobbins, having each two or more primary and two or more secondary coils, the coils being wound in such a direction as to give the necessary polarity to the iron cores. From this arrangement it will be seen that on making and breaking contact with a voltaic battery in circuit with the primary coils of all the bobbins powerful induction will take place at each end of the iron cores, inducing currents in the secondary coils as though these were being excited by a rotating armature driven by a separate source of power. (*Provisional only.*)

City Notes.

Old Broad Street, April 14th, 1880.

DIRECT SPANISH TELEGRAPH COMPANY.—The half-yearly general meeting of this Company was held on Wednesday, the 31st ult., at the offices, Cannon Street. Mr. Neil Bannatyne presided, and, in moving the adoption of the report (an abstract of which appeared

in our last issue), said that everything connected with their revenue went on very favourably till close on the end of the year. In October a fault was discovered in their cable, but it was repaired, and it caused no interruption in their traffic; but at the end of December they received telegraphic information that the Bilbao cable had broken down. It occurred at a most unfortunate period, and the repair was rendered a very difficult task owing to the bad weather. The repair had, however, been effected, and the electrical condition of the cable was now as perfect as ever. He was happy to inform them that since they resumed work their traffic had come back to them, and their receipts had been highly satisfactory since. There had also been an improvement on the Marseilles and Barcelona cable. He expressed the regret of the board that they could not recommend a dividend either on the preference or ordinary shares, owing to the cost of the repair of the cable. Although their receipts for the half-year had shown such a considerable increase the expenses remained at what they regarded as the normal figure. He then referred to the great development of the Bilbao traffic since the revival in the iron trade. The word-rate system would come into operation immediately, and he hoped, as in the cases where it had already been adopted, their receipts would be beneficially affected by the change. In reply to a question, the Chairman said he believed the balance of profit and loss account, £2,200, and the reserve fund of £4,450, would more than suffice for the cost of the repair of the cable. The report was adopted.

INDO-EUROPEAN TELEGRAPH COMPANY.—The ordinary general meeting of this Company was held at the Cannon Street Hotel on Wednesday, the 31st ult. Colonel James Holland was in the chair, and, in submitting for approval the report and accounts of the year 1879, he stated that the Company was in the predicament in which countries were said to be happiest—viz., when they had no history. They had been carrying on their work during the past year in a fairly prosperous condition—not by leaps and bounds, making large sums of money, but by continuing fairly well the reasonable progress they made the year before. In that year they made the largest income they had ever before realised, and this last year they had exceeded that by about £1,100, while the turn-out generally would have been still better than it had been but for what very often happened in the course of events—a few exceptional cases, in which, however, there was nothing of the slightest importance as materially affecting the Company's interests. The expenditure had been only a little in excess of that of the previous year, and the excess had been incurred for necessary and beneficial objects, which included the acquisition of property for building of new offices. Up to the end of last month the only debt owing to the Company upon any of the accounts was one of a few hundred pounds, which was due from the Indian Government, and was therefore considered perfectly safe. A sum between £2,500 and £2,600 had been paid to Messrs. Siemens in formal settlement of a debt connected with various affairs in Persia. With regard to the meeting of the International Telegraph Conference in London last year, the Chairman said it had settled telegraph affairs for the next five years, the next meeting having been appointed to be held at Berlin in 1884; and he believed that most parties, especially the mercantile community, would be glad that it was so. The Company had no reason to complain of what was done at that conference; because, although their own interests were not specially considered, they regarded the results as being reasonable and fair to all parties. The Company had not yet succeeded in obtaining from the Russian Government a decision upon their claims on account of the destruction of some 60 or 70 miles of telegraph during the Russo-Turkish war, but the matter was still under discussion, and the Company looked to the Russian Government to do what was right. The Chairman concluded by moving that the report, the substance of which has already been published, and the accounts should be received and adopted. The motion was seconded by Mr. W. H. Barlow. Mr. Ford asked whether the directors would not think it desirable to have half-yearly instead of only yearly meetings. He was of opinion himself that they ought to be half-yearly. Mr. Beard took the same view. Mr. Hofner was opposed to half-yearly meetings, but recommended a monthly or weekly publication of the accounts. The Chairman said the directors would offer no objection to half-yearly meetings if any general desire was expressed on the part of the shareholders in that direction, but he did not understand that any such feeling was generally entertained. To the monthly or weekly publication of the accounts there were various objections, and he did not think the shareholders generally would be in favour of that course. Mr. Ford was opposed to the monthly or weekly publication of the accounts. The motion for the adoption of the report was unanimously agreed to, and a dividend of 6 per cent. was declared for the year. The retiring directors, General Tremenheere, and Messrs. Tritton and Weaver, were re-elected, and Messrs. Kemp, Ford, and Company were reappointed auditors. The proceedings then closed with a vote of thanks to the chairman.

THE GREAT NORTHERN TELEGRAPH COMPANY'S working account for the year 1879 shows that the traffic receipts from the stations in Europe amounted to £89,748 1s. 11d.; and from those in China and Japan to £114,295 10s. 11d., making a total of £204,043 12s. 10d. Interim dividends amounting to 5 per cent. have already been paid, and an extra dividend of 2s. 9d. per share is now notified, leaving, after additions to the reserve, renewal, and pension funds, and the payment to the directors, a balance to be carried forward of £16,242 7s. 4d.

THE EASTERN EXTENSION, AUSTRALASIA, AND CHINA TELEGRAPH COMPANY, LIMITED.—The report of the directors for the six months ended 31st December, 1879, to be presented at the thirteenth ordinary general meeting of the Company, to be held at the City Terminus Hotel, Cannon-street, on Wednesday, the 21st day of April, 1880, at two o'clock, states that the total receipts for that period have amounted to £165,930 11s. 2d., against £140,976 11s. 1d. for the corresponding half-year of 1878, giving an increase of £24,954 0s. 1d. The working and other expenses (including a sum of £22,864 5s. 3d. for cost of repairs and renewals of cables and expenses of ships), together with interest on debentures and income tax, absorb £68,683 6s. 3d., leaving a balance of £97,247 4s. 11d. as the net profit for the half-year, which, with £34,660 6s. 9d. brought forward from the previous half-year, makes a total of £131,907 11s. 8d. to be dealt with. One interim dividend of 14 per cent., amounting to £24,968 15s., has been paid for the half-year, and it is now proposed to distribute another of similar amount payable on the 22nd April, making, with the two interim dividends paid for the first half-year, a total distribution of 5 per cent. for the year 1879. The balance, amounting to £81,970 1s. 8d., has been carried to the reserve fund, which now stands at £157,870 17s. 6d. Having regard to the extension of the Company's cables, the directors desire that the reserve fund should accumulate to an amount proportionate to the capital, and sufficient to guarantee the

stability of the Company's system. The directors have to announce that the remaining section of the duplicate Australian cable, viz., between Singapore, Java and Australia, was successfully laid on the 29th January, or a month within the time fixed by the contract with the Australian Governments for the completion of the work. The alterations in the Manila concession referred to by the chairman at the last general meeting having been obtained from the Spanish Government, a contract has been entered into by the Company with the Telegraph Construction and Maintenance Company for carrying out its provisions. The whole of the cable has been manufactured and shipped, and is now on its way to Manila. The work is expected to be fully completed in the course of the next month. All the cables of the Company continue to work satisfactorily. In accordance with Article 13 of the Articles of Association, Mr. F. A. Bevan, Mr. C. W. Earle, and Baron d'Erlanger retire by rotation. The two former being eligible, offer themselves for re-election. Baron d'Erlanger does not offer himself for re-election. The retiring auditors, Mr. Henry Dever and Messrs. Quilter, Ball & Co., offer themselves for re-election.

THE DIRECT UNITED STATES CABLE COMPANY, LIMITED, notify that the Interim Coupon for interest to 15th April, on their 6 per cent. Debenture Loan, will be paid on and after that date at the Consolidated Bank, 52, Threadneedle Street, London, E.C.

WE gather from the last administration report of the Indo-European Telegraph Department for 1878-9 that the net revenue of the year amounted to £7,328, a decided improvement on the previous year's working, when there was a net loss of £40,182, the length of lines working being the same in both years. The director, Lieut-Colonel J. U. Bateman-Champain, R.E., considers that these figures show as favourable a state of working as can reasonably be expected. In the Persian Gulf on several occasions the cables were interrupted, but the cable and land line were never simultaneously stopped. The distance between London and Teheran is 3,800 miles; the average time of transit of all messages is given as 17min. 30sec.; while the time occupied in transmitting messages between Teheran and Bushire is stated at 2min. 58sec. In all about 35,000 messages, comprising 700,000 words, were sent; of these 32,000 were through messages between Europe and India and the far East.

THE coupons of the Submarine Cables Trust, due on 15th inst., will, under authority of the Court, be paid, on and after that date, by Messrs. Glyn, Mills & Co.

THE GLOBE TELEGRAPH AND TRUST COMPANY (LIMITED) notify that interim dividends for the quarter ending 18th inst. of 3s. per share on the Preference Shares, being at the rate of 6 per cent. per annum, and 2s. per share on the Ordinary Shares, at the rate of 4 per cent. per annum, both free of income-tax, will be paid after the 20th instant.

THE opening of telegraphic communication by "La Compagnie Française" between England and the States is still delayed, the shore end of the cable from Brest to Penzance not being yet put down.

The following are the final quotations of telegraphs:—Anglo-American, Limited, 58¾-59¼; Ditto, Preferred, 88½-89½; Ditto, Deferred, 33-33⅛; Brazilian Submarine, Limited, 7⅛-7⅛; Cuba, Limited, 9½-10; Cuba, Limited, 10 per cent. Preference, 16⅛-16¾; Direct Spanish, Limited, 2-2⅛; Direct Spanish, 10 per cent. Preference, 10¼-11; Direct United States Cable, Limited, 1877, 11-11¼; Scrip of Debentures, 100-102; Ditto, £25 paid, par-2 pm.; Eastern, Limited, 9-9¼; Eastern 6 per cent. Preference, 12⅛-12⅜; Eastern, 6 per cent. Debentures, repayable October, 1883, 104-107; Eastern 5 per cent. Debentures, repayable August, 1878, 101-103; Eastern, 5 per cent., repayable Aug., 1899, 101-103; Eastern Extension, Australasian and China, Limited, 8⅞-9⅛; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 105-108; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 100-102; Ditto, registered, repayable 1900, 101-103; German Union Telegraph and Trust, 8¾-9¼; Globe Telegraph and Trust, Limited, 5⅛-5⅜; Globe, 6 per cent. Preference, 11⅛-11⅜; Great Northern, 9⅛-9⅞; Indo-European, Limited, 24-25; London Platino-Brazilian, Limited, 4½-5; Mediterranean Extension, Limited, 3-3⅛; Mediterranean Extension, 8 per cent. Preference, 10½-11⅛; Reuter's Limited, 10-11; Submarine, 230-240; Submarine Scrip, 2-2⅛; West Coast of America, Limited, 2⅛-2⅜; West India and Panama, Limited, 1⅛-1⅛; Ditto, 6 per cent. First Preference, 7⅛-8; Ditto, ditto, Second Preference, 7-7⅛; Western and Brazilian, Limited, 7-7⅛; Ditto, 6 per cent. Debentures "A," 100-103, Ditto, ditto, ditto, "B," 100-103; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 102-104; Telegraph Construction and Maintenance, Limited, 33⅛-34; Ditto, 6 per cent. Bonds, 104-108; Ditto, Second Bonus Trust Certificates, 3-3⅛; India Rubber Co., 14⅛-15⅛; Ditto, 6 per cent. Debenture, 103-105.

NEW ANGLO-AMERICAN CABLES.—In reply to a message from President Green, of the Western Union Telegraph Company, inquiring whether the Anglo-American Telegraph Company are likely to lay another cable during the coming summer to meet the largely increased business, Mr. Weaver, the general manager, replied as follows:—"Yes, I am now negotiating the contract for two cables:—one from Valentia to Heart's Content, with a new form of outer covering for its better protection in deep sea, and the second from Placentia to Sydney, touching at St. Pierre, containing at least three conducting wires, with an exceptionally heavy outer covering, weighing seven tons per knot, and the shore ends of a heavier type. I think you will do well to put up another wire at least. I should have thought two more would be required." Dr. Norvin Green answered as follows:—"The additional wire proposed will be of No. 4 gauge, and worked quadruplex."—*Journal of the Telegraph.*

THE Brush machines and lamps for use in England are henceforth to be manufactured at the telegraph works of W. T. Henley & Co., Limited.

THE *Magnet* facetiously remarks that, when Mr. Edison was last heard of, he was searching for his electric light by the aid of a tallow candle.

A WONDERFUL INVENTION—ELECTRICITY STORED IN TANKS TILL WANTED.—"The machine for this purpose consists of an electro-dynamic machine, driven by a powerful engine. A second apparatus, called the electrometer, or reservoir, is used in connection with the dynamic machine. This consists in huge Leyden jars, or tanks, resembling those used in the manufacture of gas. These are 55 feet in diameter and 22 feet in height. The cover is movable, and has a weight of over nine tons. The electricity is manufactured in the machine, and is forced into the electrometers at the bottom. This causes the lid to rise until the space inside is filled with electricity. By using a sufficient quantity of these electrometers, enough electricity can be stored up to last the company a year, thus doing away with the constant use of the engine. The electrometer is tapped at the bottom and the wires inserted. A constant stream of electricity flows over the wire as the lids press equally on it by its enormous pressure." The above it is, perhaps, unnecessary to say is from America.